Laser Diode and LED Applications
Conference Chair: Kurt J. Linden, Spire Corp.
Oral Presentation

UCRL-JC-124910 Abs

Abstract Title: High-power laser diode-pumped Yb:YAG, Tm:YAG, and Cr:ZnSe laser systems

Authors: J. A. Skidmore, M. A. Emanuel, B. Freitas, R. J. Beach, C. Bibeau, E. C. Honea, R. H. Page, S. B. Sutton, and S. A. Payne

Abstract:

High-power laser diode arrays have been developed for scaleable end-pumped solid state laser systems. We have designed and fabricated InGaAs laser diodes with projected lifetimes of ~10,000 hours at output powers of 30 W per linear cm. These diodes utilize a large transverse waveguide which increases the COD limit and reduces the output divergence for better microlens-collection efficiency.

Many applications motivate the development of a reliable, compact CW laser system emitting at 1 µm. Compared to Nd:YAG, Yb:YAG offers a longer storage time (~ 1 ms), lower quantum defect (3 x), wider absorption band, and the use of InGaAs active layers which enhances diode reliability. More than 150 W of CW power with an optical-to-optical efficiency of 25% was achieved with this design, which represents the highest power ever reported for this system. We have also end-pumped a Tm:YAG laser that utilizes 805 nm diodes. By pumping away from the main absorption peak it is possible to create sufficient population inversion to overcome ground state reabsorption and still allow efficient laser operation. An InAlGaAs laser diode array produced 460 W of CW power at 805 nm from a 2.4 cm long stack of microlens-conditioned 1-cm long laser bars. The Tm:YAG laser has produced 115 W of CW power. Both lasers utilize similar pump geometries, cooling cavities, and laser rods with diffusion bonded undoped end-caps in a modular architecture that is rugged, compact and scaleable to high average power.

We have developed the first diode-pumped tunable mid-IR laser. InGaAsP/InP diode bars emitting at 1.65 µm were used to pump a Cr:ZnSe crystal which is tunable from ~ 2 to 3 µm. A peak output power of 0.34 W was achieved with a four-bar microlens-conditioned array operating at 60 W peak power. The output performance of these types of microlens-conditioned laser diode arrays will continue to expand the number of ion-host combinations that can be realized in diode-pumped solid-state laser systems.

* This work was performed under the auspices of the US Department of Energy by Lawrence Livermore National Laboratory under contract W-7405-Eng-48.

KEY WORDS: laser diodes, diode-pumped solid-state lasers

BIOGRAPHY OF PRINCIPAL AUTHOR:

Jay A. Skidmore is an engineer at Lawrence Livermore National Laboratory. His research interests include design, fabrication and packaging of high-power laser diodes.

Author information:

name	L-code	phone	fax	email
Skidmore, Jay A.	L-441	422-0089	3-6195	jskidmore@llnl.gov
Emanuel, Mark A.	L-441	423-6837	3-6195	emanuel1@llnl.gov
Freitas, Barry L.	L-250	423-8053	3-3361	
Beach, Raymond J.	L-441	423-8986	3-6195	
Bibeau, Camille	L-441	422-7798	3-6195	
Honea, Eric C.	L-441	422-8118	3-6195	
Page, Ralph H.	L-441	422-2774	3-6195	
Sutton, Steven B.	L-441	422-0322	3-6195	
Payne, Steve	L-441	423-5070	3-6195	